

Applicant: Pekka Linnonmaa et al.
Application No.: 10/598,664
Response to Office action mailed Sep. 20, 2007
Response filed December 18, 2007

Claim Listing

1–58. (cancelled)

59. (new) A method of forming a calendered paper web comprising the steps of: manufacturing and drying a paper web in a paper machine, moisturizing the dried paper web to a moisture content of 4–7% and reeling the paper web into a machine reel; un-reeling the paper web and calendering the paper web in a multinip calender whose roll assembly is formed of a first set of rolls and a second set of rolls, the second set of rolls arranged after the first set of rolls in a travel direction defined by the travel of the paper web, the paper web traveling over guide rolls between rolls of the first set of rolls and the second of rolls; wherein the paper web is calendered in the first set of rolls arranged to form first successive nips between superimposed rolls having a flexible coating and heated metal rolls having a smooth surface following each other alternately in the travel direction; wherein the paper web is calendered in the second set of rolls arranged to form second successive nips between superimposed rolls having a flexible coating and heated metal rolls having a smooth surface following each other alternately in the travel direction; moisturizing one surface of the paper web with at least one pre-moisturizer and raising the paper web to a moisture content of 8–12%, and thereafter passing the paper web to a first calender nip of the first successive nips of the first set of rolls, and then through said first successive nips of the first set of rolls; moisturizing an opposite surface of the paper web with at least one intermediate moisturizer and raising the paper web to a moisture content of 6 – 10 %, and thereafter passing the paper web to a first calender nip of the second successive nips of the second set of rolls, and then through said second

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successive nips of the second set of rolls;
wherein the at least one pre-moisturizer is spaced from the first calender nip so that
the travel of the paper web in the travel direction toward the first calender nip
of the first successive nips of the first set of rolls defines a first absorption time
of the moistening medium sprayed by the pre-moisturizer and wherein the
intermediate moisturizer on the opposite surface of the paper web is spaced
from the first calender nip of the second successive nips of the second set of
rolls so that the travel of the paper web in the travel direction toward the first
calender nip of the second set of rolls defines a second adsorption time
substantially the same as the first adsorption time;
wherein the paper web is calendered to a roughness of 1.0 –1.1 μm and a gloss of
54–60 %.

60. (new) The method according to claim 59, further comprising the steps of:
using a second pre-moisturizer to moisturize the paper web so that both sides of the
web are pre-moisturized; and

calendering the paper web to a roughness of 1.0 –1.1 μm and a gloss of 56–60 %.

61. (new) The method according to claim 59, wherein the moisturizing of the
paper web and the multinip calender are controlled by measuring moisture content or gloss of
the paper web and adjusting pressure in the nip of the multinip calender and the heated rolls
temperatures by a control unit on the basis of a control signal determined from said measuring
moisture content or gloss of the paper web.

62. (new) The method according to claim 59, wherein the first set of rolls and the
second set of rolls comprise four nips or the first set of rolls and the second set of rolls
comprise five nips.

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63. (new) The method according to claim 59, wherein the moisturizing of the paper web with the pre-moisturizer is preformed against a roll.

64. (new) The method according to claim 59, wherein the moisturizing of the opposite surface of the paper web with at least one intermediate moisturizer is preformed against a roll.

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65. (new) An apparatus for calendering a paper web comprising:
an unwinder containing a first reel with a moisture content of 4 – 7%;
a multinip calender following the unwinder and in paper web receiving relation to the
first reel contained therein;
a reel-up containing a second reel in paper web receiving relation to the multinip
calender;
a paper web extending from the first reel to the second reel;
wherein the multinip calender is formed of a first set of rolls and a second set of rolls,
the second set of rolls arranged after the first set of rolls in a travel direction
defined from the first reel to the second reel, the paper web extending over
guide rolls between rolls of the first set of rolls and the second set of rolls;
wherein the paper web extends through first successive nips of the first set of rolls, the
first successive nips being formed between superimposed rolls having a
flexible coating and hot metal rolls having a smooth surface which follow each
other alternately in the travel direction;
wherein the paper web extends through second successive nips of the second set of
rolls, the second successive nips formed between superimposed rolls having a
flexible coating and hot metal rolls having a smooth surface following each
other alternately in the travel direction;
at least one pre-moisturizer positioned before the calender and arranged to moisturize
a first surface of the paper web wherein a portion of the paper web
immediately following the pre-moisturizer and extending to the multinip
calender has a moisture content of 8–12%;
at least one intermediate moisturizer positioned between the first set of rolls and the
second set of rolls of the calender and arranged to moisturize a second and
opposite surface of the paper web, wherein a portion of the paper web
immediately following the at least one intermediate moisturizer and extending
to the second set of rolls has a moisture content of 6 – 10 %;

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wherein the at least one pre-moisturizer is spaced from a first calender nip of the first successive nips of the first set of rolls a selected distance, and wherein the at least one intermediate moisturizer on the opposite surface of the paper web is spaced from a first calender nip of the second successive nips of the second set of rolls substantially the selected distance; and
wherein the paper web following the multi-nip calender and extending to and forming the second reel has a roughness of $1.0 - 1.1 \mu\text{m}$ and a gloss of 54–60 %.

66. (new) The apparatus of claim 65, further comprising a second pre-moisturizer positioned before the calender and arranged to moisturize the second opposite surface of the paper web arranged with the at least one pre-moisturizer to moisturize the paper web so that both sides of the web are pre-moisturized; and

wherein the paper web following the multi-nip calender, and extending to and forming the second reel has a roughness of $1.0 - 1.1 \mu\text{m}$ and a gloss of 56–60 %.

67. (new) The apparatus of claim 65, further comprising:
a plurality of moisture content or gloss measuring devices positioned before and after the multi-nip calender, and between the first set of rolls and the second set of rolls;
a control unit in control signal receiving relation to said plurality of moisture content or gloss measuring devices and in nip pressure adjusting relation to the multinip calender, and in temperature adjusting relation to the hot rolls of the first set of rolls and the hot rolls of the second set of rolls.

68. (new) The apparatus of claim 65, wherein the first set of rolls and the second set of rolls comprise four nips or the first set of rolls and the second set of rolls comprise five nips.

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69. (new) The apparatus of claim 65, wherein the at least one pre-moisturizer is positioned opposite a roll.

70. (new) The apparatus of claim 65, wherein the at least one intermediate moisturizer is positioned opposite a roll.